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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/904,112

07/11/2001

Cem Basceri

MIO 0057 PA (98-1070)

1085

7590

11/18/2004

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EXAMINER

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ART UNIT

PAPER NUMBER

2812

DATE MAILED: 11/18/2004

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GROUP 2800

**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 09/904,112
Filing Date: July 11, 2001
Appellant(s): BASCERI ET AL.

Susan M. Luna
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed June 2, 2003.

(1) *Real Party in Interest*

A statement identifying the real party in interest is contained in the brief.

(2) *Related Appeals and Interferences*

The brief does not contain a statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief. Therefore, it is presumed that there are none. The Board, however, may exercise its discretion to require an explicit statement as to the existence of any related appeals and interferences.

(3) *Status of Claims*

This appeal involves claims 1-6, 8-10, 15, 22-30, 37-42, 43-46, 50, 57-63, 74-76, 100-105.

Claims 11-12 are allowed.

Claims 47-49 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

(4) *Status of Amendments After Final*

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) *Summary of Invention*

The summary of invention contained in the brief is correct.

(6) *Issues*

The appellant's statement of the issues in the brief is correct.

(7) *Grouping of Claims*

The rejection of claims 1-6, 15, 22-30, 37-42, 45-46, 74-46, and 100-105 stand or fall together because appellant's brief does not include a statement that this grouping of claims does not stand or fall together and reasons in support thereof. See 37 CFR 1.192(c)(7).

The rejection of claims 8-10, 43-44, 50, and 57-61 stand or fall together because appellant's brief does not include a statement that this grouping of claims does not stand or fall together and reasons in support thereof. See 37 CFR 1.192(c)(7).

The rejection of claims 62-63 stand or fall together because appellant's brief does not include a statement that this grouping of claims does not stand or fall together and reasons in support thereof. See 37 CFR 1.192(c)(7).

(8) *Claims Appealed*

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) *Prior Art of Record*

6,235,572	Kunitomo et al.	5-2001
5,879,957	Joo	3-1999
5,555,486	Kingon et al.	9-1996

(10) *Grounds of Rejection*

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in-

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or
(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

Claims 1-6, 15, 22-30, 37-42, 45-46, 74-76, and 100-105 are rejected under 35 U.S.C. 102(e) as being anticipated by Kunitomo et al. (U.S. Patent No. 6,235,572).

Kunitomo et al. disclose the method of forming a capacitor comprising providing a conductive oxide electrode (RuO_x) (51), depositing a first layer of a high dielectric constant oxide dielectric material (Ta_2O_5) on the conductive oxide electrode, oxidizing the conductive oxide electrode and the first layer of the high dielectric constant oxide dielectric material (Ta_2O_5) under oxidizing conditions (see column 18, line 45 through column 19, line 45) such that at least the surface area of the conductive oxide electrode is provided with enough oxygen to provide stability with the first layer of high dielectric constant oxide material, depositing a second layer of the high dielectric constant oxide dielectric material (Ta_2O_5) on the first layer of the high dielectric constant oxide dielectric material, oxidizing the second layer of high dielectric constant oxide dielectric material (see column 19, lines 46-58), and then depositing an upper layer electrode (RuO_x) (62) on the second layer of the high dielectric constant oxide dielectric material.

Kunitomo et al. further disclose the method wherein the first high dielectric constant oxide dielectric material is oxidized using a gas plasma (see column 2, lines 18-21), and the gas selected from the group consisting of O₂ and O₃, at a temperature from a range of about 250 °C to about 500 °C (see column 18, line 45 through column 19, line 45).

Kunitomo et al. also disclose the method wherein the second layer of high dielectric constant oxide dielectric material is oxidized by rapid thermal oxidation, at a temperature of less than about 700 °C in the presence of a gas selected from the group consisting of O₂ and N₂O conditions (see column 18, line 45 through column 19, line 45).

Kunitomo et al. also disclose the method wherein a field effect transistor (13, 14, 15) having a pair of source/drain regions (22, 23) is provided, electrically connecting one the source drain region with the conductive oxide electrode and the other of said source drain regions with a bit line (BL) (see Figure 35).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 8-10, 43-44, 50, and 57-61 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kunitomo et al. (U.S. Patent No. 6,235,572) in view of Joo (U.S. Patent No. 5,879,957).

Kunitomo et al. disclose the method substantially as claimed, and rejected above, but does not disclose the method of oxidizing the upper layer electrode utilizing gas plasma and a temperature range from about 250 to 500 °C. Joo discloses the method of oxidizing an electrode utilizing gas plasma (see column 4, lines 46-56). It would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize the upper electrode by a gas plasma technique as disclosed in Joo in order to avoid a heat treatment at a high temperature.

The selection of the range of temperature is obvious because it is a matter of determining optimum process condition by routine experimentation with a limited number of species. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and In re Boesch, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious).

Claims 62-63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kunitomo et al. (U.S. Patent No. 6,235,572) and Joo (U.S. Patent No. 5,879,957), in view of Kingon et al. (U.S. Patent No. 5,555,486).

Kunitomo et al. and Joo et al. disclose the method substantially as claimed and rejected above, but do not disclose the method of forming a platinum electrode on the upper layer electrode. Kingon et al. discloses the method of forming a platinum

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electrode upon an upper electrode (see column 6, lines 38-45). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a platinum electrode upon an upper electrode in order to reduce leakage current.

While, Kingon et al. does not disclose first forming the gas permeable electrode and then performing the oxidizing step so that the oxidation occurs through said gas permeable electrode the examiner notes that the selection of any order of performing process steps is prima facie obvious in the absence of new or unexpected results. In re Burhans, 154 F.2d 690, 69 USPQ 330 (CCPA 1946). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the gas permeable electrode and then oxidize the upper electrode.

(11) Response to Argument

Group I: Claims 1-6, 15, 22-30, 37-42, 45-46, 74-46, and 100-105.

Applicant argues that Kunitomo et al. do not teach a method in which the lower electrodes and tantalum oxide layer are oxidized as claimed. Yet, Applicant does not provide any evidence in support of this argument. While Applicant agrees that Kunitomo et al. clearly disclose the method of crystallizing the tantalum in an oxidation atmosphere, Applicant merely alleges that the lower electrodes are not oxidized.

The examiner notes that arguments of counsel cannot take the place of evidence in the record. In re Schulze, 346 F.2d 600, 602, 145 USPQ 716, 718 (CCPA 1965); In re Geisler, 116 F.3d 1465, 43 USPQ2d 1362 (Fed. Cir. 1997) ("An assertion of what seems to follow from common experience is just attorney argument and not the kind of factual evidence that is required to rebut a prima facie case of obviousness.").

Kunitomo et al. disclose that oxidation of the lower electrode occurs. Because applicant did not provide any evidence to contradict this teaching the conclusory statements that oxidation does not occur cannot overcome the evidence of the prior art.

The examiner further notes that in Column 19, lines 15-27, Kunitomo et al. discuss alternatives on how to prevent the lower electrode from being oxidized in the heat treatment and oxidation of the tantalum oxide layer. In stating these alternatives, Kunitomo et al. teach that the lower electrodes are oxidized in the previously described methods. For instance, Kunitomo et al. teach that the tantalum oxide film, and, consequently, the lower electrode are subjected to a heat treatment at a temperature of 650°C or more in an oxidation atmosphere (see column 18, lines 46-62). Further, Kunitomo et al. teach that in "the case where the oxidation of the lower electrodes 54 is a matter...the tantalum oxide film can thereafter subjected to oxidation processing under such a loose condition that the lower electrode is not oxidized". Kunitomo et al. also teach that "processing at 400 °C in an ozone atmosphere is cited as an example of the oxidation processing under a loose condition." (see column 19, lines 15-27). Thus, Kunitomo et al. teach that mild conditions such as low temperature of 400°C are required to prevent oxidation of the lower electrode. However, conditions that are listed

above in column 18, line 45 through column 19, line 27 with higher temperatures will necessarily oxidize the lower electrode.

Furthermore, support for the argument that the oxidizing atmosphere indeed oxidizes the lower electrode may be found in column 20, line 63 through column 21, line 27. In this passage, Kunitomo et al. teach that the lower electrode may be oxidized by oxidation processing when forming the tantalum oxide films. Kunitomo et al. also teach that the lower electrodes of ruthenium oxide can be formed by a sputtering method or a CVD method and further have been oxidized when performing the crystallization process of the tantalum oxide film (column 21, lines 15-34).

On page 7 of the Appeal Brief, Applicant admits that the lower electrodes in Kunitomo et al. are oxidized when performing the crystallization process of the tantalum oxide film if one chooses ruthenium oxide as the conductive oxide electrode. The examiner notes that Kunitomo et al. disclose that ruthenium oxide may be used as the lower electrode and, thus the lower electrodes are oxidized (see column 18, lines 15-17).

Applicant argues that Kunitomo et al. do not disclose that the conductive oxide is provided with enough oxygen so as to be stable with the oxide dielectric layer. The examiner disagrees. In the specification the Applicant teaches that the oxidation of the lower electrode provides the conductive oxide with enough oxygen so as to be stable with the oxide dielectric layer (specification page 7, lines 20-30). Because in Kunitomo et al. the lower electrode is oxidized, it follows that the conductive oxide is provided with

enough oxygen so as to be stable with the oxide dielectric layer. Thus this limitation is also is met.

In re claim 2, the Applicant argues that Kunitomo et al. do not teach or suggest oxidation of the lower electrode and the dielectric material by a gas plasma treatment. The examiner directs applicant's attention to column 2, line 18-21 where Kunitomo et al. state a gas plasma may be used to oxidize a tantalum oxide film to improve the quality of the film. The examiner also notes in the response filed September 23, 2002 (page 3, lines 1-5), Applicant admitted that "Kunitomo discloses that either a thermal or plasma treatment may be used for oxidation..."

Applicant also argues that Kunitomo et al. teach away from using a plasma treatment because Kunitomo et al. state that tantalum oxide films subjected to plasma treatment have a lower dielectric constant than crystallized tantalum oxide films. The examiner respectfully disagrees. Kunitomo et al. teach both the benefits and drawbacks of oxidation and crystallization of tantalum oxide. Specifically, Kunitomo et al. teach that thermal and plasma oxidation improve the quality of the tantalum oxide, but do not produce a layer that has the high dielectric constant of a crystallized tantalum oxide. Kunitomo et al. also teach that the method of crystallization improves the dielectric constant, but creates grain boundary allowing for leakage current (see column 2, lines 10-55). Kunitomo et al. therefore, was only teaching that the oxidation alone, whether by thermal or plasma methods, and crystallization alone, were not preferred embodiments. Rather, the combined the methods of oxidizing and crystallizing are preferred so as to obtain the benefits of oxidation to improve the film quality, and

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crystallization to improve the dielectric constant. If Kunitomo et al. were teaching away from gas plasma, then they would also teach away from a thermal treatment and crystallization. This is clearly not the case since it is certain that a thermal treatment and crystallization method are used in treating the tantalum pentoxide film (see also column 18, line 45 through column 19, line 15).

In re claim 4, Applicant states that Kunitomo et al. do not disclose Applicant's claimed temperature range of from about 250 °C to about 500 °C. The examiner notes that Kunitomo et al. teaches 400 °C (column 2, lines 18-21) and a temperature of 300 to 500 °C (see column 19, lines 10-15). The disclosed ranges of Kunitomo et al. therefore overlap with the claimed range.

In re claim 6, Applicant argues that Kunitomo et al. teach only the use of crystallized tantalum oxide film while the claim at hand requires the use of an amorphous tantalum oxide. The examiner notes that the claim at hand does not require that the final product after oxidizing and subsequent processing be amorphous, only that the high dielectric constant material be amorphous at some point during the process. A film may either be crystalline or non-crystalline (amorphous). Kunitomo et al. disclose the method of crystallizing the tantalum oxide to make the film crystalline, and thus, it follows, that the film prior to crystallizing would be amorphous (see column 18, lines 45-48). For further support the examiner points to column 2, lines 10-17, in which Kunitomo et al. teach that "it is difficult to deposit a tantalum oxide film at a high temperature since an (sic) tantalum oxide film is generally formed by a CVD method using an organic tantalum gas. Therefore, the tantalum oxide film as deposited is in an

amorphous state and must be subjected to a thermal treatment to crystallize the film”

Kunitomo et al. then teach the tantalum oxide film formed and subsequently crystallized is deposited by a thermal CVD metal at a low temperature of 550 ° C or less with an organic tantalum gas (pentaethoxytantalum or pentaalkyltantalum; see column 18, lines 28-37). Therefore, Kunitomo et al. have formed the tantalum oxide of column 18, lines 28-37 by a method that they disclose would result in an amorphous film.

In re claim 28, Applicant argues that Kunitomo et al. do not disclose the method of oxidizing and crystallizing the second layer of dielectric material. The Applicant states on page 8 of the Appeal Brief that “As pointed out above, Kunitomo et al. do not teach or suggest oxidizing their second film layer 58, nor do Kunitomo et al. teach providing the surface area of the conductive oxide electrode with sufficient oxygen to be stable with the first layer of the oxide dielectric material as claimed”. The examiner can find no place in the appeal brief where this argument has been made with respect to the second tantalum oxide film 58. Assuming applicant means to refer to the argument present with respect to the first tantalum oxide layer 56, the examiner notes that Kunitomo et al. teach the second layer of tantalum oxide film is formed, oxidized and crystallized in the same manner as the first layer 56.

“Deposition of the tantalum oxide film 57 can be achieved in the same manner as in the tantalum oxide film 55. Further, the tantalum oxide film 57 is subjected to and crystallized by a heat treatment thereby to form a second crystallize (sic) tantalum oxide film 58. The method of crystallizing

the tantalum oxide film 57 is the same as that of crystallizing the tantalum oxide film 55 thereby to form a crystallized tantalum oxide film 56. A capacity insulating film comprising the crystallized tantalum oxide films 56 and 58 is thus formed." (see column 19, lines 45-58).

Since the second tantalum oxide film is made in the same way as the first tantalum oxide film the film is necessarily oxidized and crystallized as argued above with respect to claim 1.

Applicant also argues that Kunitomo et al. do not teach rapid thermal oxidation. The examiner notes that Kunitomo et al. teach a thermal process with a treatment period of 1 to 10 minutes. The examiner maintains this is classified as a rapid thermal process, as it is readily known by one skilled in the art that heat treatment for about 5 minutes is considered rapid thermal processing. The examiner cites Nam (U.S. Patent No. 6,248,640) column 2, line 47-52) and Sung et al. (U.S. Patent Appl. No. 2002/0058410), paragraph [0025]) in Appendix A support for this known understanding of rapid thermal processing.

In re claim 40, Applicant argues that Kunitomo et al. do not teach oxidizing both the lower electrode and the tantalum oxide film 56 by a gas plasma treatment as claimed. The applicants further argue that Kunitomo et al. do not teach that the surface of the electrode 54 is provided with enough oxygen to provide stability with the first

tantalum oxide film layer 56. The examiner has addressed these arguments above in the response to claims 1 and 6.

The Applicant further argues that while Kunitomo et al. list ruthenium oxide as a lower electrode one would have to pick from among several of Kunitomo's disclosed materials including tungsten, titanium nitride and ruthenium. The applicant cites that for a single reference to anticipate requires disclosure of all elements of the claimed invention arranged as in that claim. *Panduit Corp. V. Dennison MFG. Co.*, 227 USPQ 337, 350 (Fed Cir. 1985). As stated above, Kunitomo et al. does disclose all of the elements of the claimed invention as arranged in the claim, ie. a ruthenium oxide lower electrode (see column 18, lines 13-17). Applicant kindly reminded examiner that the present claims are directed to method not to a chemical compound. The examiner notes that the method as claimed had been rejected, but that the issue at hand however is a chemical compound, and thus the argument was addressed accordingly.

Further, the examiner maintains the species/genus logic is applicable since the issue at hand is indeed a composition. A genus does not always anticipate a claim to a species within the genus. However, when the species is clearly named, the species claim is anticipated no matter how many other species are additionally named. *Ex parte A*, 17 USPQ2d 1716 (Bd. Pat. App. & Inter. 1990)..MPEP 2131.02

In re claim 42, Applicant again argues that Kunitomo et al. does not disclose Applicant's claimed temperature range of from about 250 °C to about 500 °C. The examiner notes that Kunitomo et al. teach 400 °C (column 2, lines 18-21) and a

temperature of 300 to 500 °C (see column 19, lines 10-15). The disclosed ranges of Kunitomo et al. therefore overlap with the claimed range.

In re claim 45, Applicant argues that while Kunitomo et al. disclose the ruthenium oxide may be used in place of titanium nitride, one would have to be motivated to pick and choose ruthenium oxide as the upper electrode and this negates anticipation. The examiner disagrees and again notes that Kunitomo et al. clearly disclose an embodiment in which ruthenium oxide is used as the upper electrode (see column 21, lines 62-65).

The arguments with respect to claims 47-49 are moot in view of examiner's withdrawal of the rejection. Claims 47-49 are therefore objected to for being dependent on a rejected independent claim.

In re claims 100-105, Applicant argues the claims are allowable for the same reasons discussed above with regard to claims 106. The examiner refers to the arguments presented above with respect to claims 1-6.

Group II: Claims 8-10, 43-44, 50, and 57-61.

To maintain a *prima facie* obviousness rejection under 35 U.S.C. 103 as decided by *Graham v. John Deere*, 383 U.S. 1, 148 USPQ 459 (1966), a three part test has been created. Firstly, one must determine the scope and content of the prior art. Secondly, the differences between the prior art and the claims are to be ascertained. Lastly, the level of ordinary skill in the art is to be determined. In other words, for

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maintaining a rejection under 35 U.S.C. 103, the Examiner must detail the relevant teachings of the prior art, the differences between the claims and the applied references and why one of ordinary skill in the art at the time of the invention would have been motivated to make the proposed combination or modification.

In re claims 8-10, applicant argues that the examiner relied upon Joo for the teaching of a method of oxidizing an upper layer electrode utilizing a gas plasma and note that the teaching refers to the formation of the ruthenium oxide layer on the ruthenium layer 35, not the oxidation of the upper layer electrode as claimed. Joo discloses forming a ruthenium oxide layer on a ruthenium layer by a thermal oxidation method or a plasma oxidation method (see column 4, lines 48-50), therefore the ruthenium layer is disclosed as being oxidized.

Furthermore, Applicant also argues that there is no suggestion in Joo or Kunitomo et al. which would lead one skilled in the art to choose a plasma oxidation method for oxidation of an upper electrode as claimed. The examiner maintains that since plasma methods are commonly done at lower temperatures than thermal oxidation methods one of ordinary skill in the art would perform a plasma method rather than a thermal method with a high temperature so that the thermal budget may be lowered. The examiner maintains that Kunitomo et al. do not teach away from gas plasma (see arguments with respect to claim 2). Further, the examiner notes that the section cited for support of Kunitomo et al. teaching away from gas plasma was directed to the oxidation of dielectric films such as tantalum oxide, not conductive films such as ruthenium oxide.

Applicant further argues that Joo teaches oxidation of a lower electrode to form ruthenium oxide and does not teach forming an upper electrode of ruthenium oxide. Kunitomo et al. disclose the method of forming an upper electrode of ruthenium oxide (see column 21, lines 63-65). Joo et al. discloses the method of oxidizing an electrode of ruthenium to form ruthenium oxide in column 4, lines 46-56. The examiner did not rely upon Joo et al. to disclose forming the upper electrode of ruthenium oxide, only to show the method of forming ruthenium oxide that could be used in the formation of the upper electrode of Kunitomo et al. One cannot show non-obviousness by attacking the references individually where, as here, the rejection is based on a combination of the references. In re Keller, 642 F.2d 413, 208 USPQ 871 (CCPA 1981). This does not address the basis for the combination.

It does not matter that Joo is not oxidizing to form an upper electrode, Joo is relied upon for the method of oxidizing ruthenium to form ruthenium oxide. et al. discloses a ruthenium oxide upper electrode. One could form the ruthenium oxide upper electrode of Kunitomo et al. by the method of oxidizing ruthenium as disclosed by Joo et al.

Applicant has correctly pointed out that claims 43-44 depend from independent claim 40, which the examiner did not reject based on the combined teaching of Kunitomo et al. and Joo. However, the examiner would like to point out that claim 40 was rejected under 35 U.S.C. 102(e) with Kunitomo et al.

In re claims 50, 57-63, Applicant argues the combination of Kunitomo et al. and Joo do not disclose the oxidation of the upper layer electrode as claimed. These arguments have been addressed in the response to claims 8-10 provided above.

In re claims 57-59, Applicant argues that neither Kunitomo et al. nor Joo teach the oxidation of the second layer of dielectric. Examiner notes that Kunitomo et al. was relied upon for disclosing oxidation of the second layer of dielectric and this argument was addressed in the response to claim 28 above.

Group III: Claims 62-63.

The arguments with respect to claims 11-12 are moot in view of examiner's withdrawal of the rejection. Claims 11-12 are allowed.

In re claims 62-63, the applicant argues that Kingon et al. does not teach the method of forming a gas permeable (Pt) electrode on the upper electrode. The examiner disagrees. Kingon discloses in one of the alternatives that a ruthenium oxide layer may be formed first followed by a platinum layer in column 6, lines 40-45. It does not matter if the reference regards the upper electrode as both the ruthenium oxide layer and platinum, this is merely semantics. In the claimed invention the platinum layer is conductive and therefore would act as part of the upper electrode just as in the reference relied upon.

Finally, applicant also argues the motivation for combining. The examiner stated that the abstract of Kingon et al., which states that the hybrid electrode structures of ruthenium oxide and platinum improve capacitor performance both in terms of fatigue

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and leakage current provides proper motivation. However, applicants assert that his refers to the benefits provided by the hybrid electrode structure, not by the formation of a gas permeable electrode on an upper electrode. The examiner notes that while Kingon et al. is not providing the platinum electrode for the same purposes as that of applicant, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

(12) Conclusion

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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November 4, 2004

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